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ANNUAL SOUTHWESTERN REGION
PEST CONDITIONS REPORT
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FOREWORD

Information on forest insect and disease conditions in the Southwest during 1983 was compiled with the assistance of the Forest Pest Management staff, Regional Office; Robert Celaya, Arizona Forestry Division; and Tony Smith, New Mexico Department of Agriculture.

Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

CONTENTS

	Page
INSECT AND DISEASE CONDITIONS	1
Conditions in Brief	1
Status of Major Insect Pests	2
Spruce beetle	2
Mountain pine beetle	2
Ips engraver beetles	2
Western spruce budworm	2
Pandora moth	4
Aspen defoliators	4
Status of Other Insects	5
Status of Pest Complexes	6
Douglas-fir mortality	6
True fir mortality	6
Ponderosa pine mortality	6
Status of Diseases	6
Dwarf mistletoes	6
Root diseases	7
Nursery diseases	7
Hazard trees	7
FOREST PEST CONDITIONS IN THE STATE OF ARIZONA	8
FOREST PEST CONDITIONS IN THE STATE OF NEW MEXICO	9
FOREST PEST MANAGEMENT ACTIVITIES IN 1983	10
Detection Surverys	10
Evaluations	11
Entomology	11
Pathology	11
Suppression Projects	12
RECENT PUBLICATIONS	12

INSECT AND DISEASE CONDITIONS

Conditions in Brief

Bark beetle-caused mortality in the ponderosa pine and mixed conifer forest types remained at an endemic level in the Southwest during 1983. Widely scattered tree mortality in these forest types was caused by the mountain pine beetle, western pine beetle, Douglas-fir beetle, Ips beetles, fir engraver beetle, and western balsam bark beetle. Spruce beetle populations remained epidemic on the Fort Apache Indian Reservation and the Santa Fe National Forest where severe tree mortality occurred on 8,500 and 8,000 acres, respectively. The spruce beetle is predicted to continue causing significant tree mortality in these locations in 1984.

The western spruce budworm continued to cause extensive defoliation of the mixed conifer forest type in both Arizona and New Mexico. Acres of visible defoliation remained near 1982 levels, although locations differed somewhat. There were 371,549 acres defoliated in 1983, compared to 368,485 acres in 1982. Defoliation decreased in northern New Mexico and Arizona, while increasing dramatically in southern New Mexico. Noticeable tree mortality was observed on both the Carson and Santa Fe National Forests in New Mexico. The western spruce budworm is expected to remain at epidemic levels in 1984.

The pandora moth defoliated approximately 23,000 acres of ponderosa pine on the Kaibab National Forest in northern Arizona. A naturally occurring virus increased in 1983, reducing the intensity of predicted defoliation levels. Tree damage resulting from this epidemic is still only minor amounts of growth loss.

Aspen defoliation, caused by the western tent caterpillar and the large aspen tortrix, occurred largely in northern New Mexico. The defoliated acreage increased to near 36,000 acres in 1983.

Southwestern dwarf mistletoe continued to be the most damaging disease of conifers. Its impact, particularly on growth and yield of ponderosa pine, was of major importance. Surveys were conducted on 40,250 acres of infected ponderosa pine stands, with resultant data used to assist in development of management alternatives for these stands.

Root diseases, principally shoestring rot and annosus rot, and associated pests were responsible for the death of an estimated 0.08 trees per acre in a survey of commerical timber lands on six National Forests in Arizona and New Mexico. A larger proportion of this mortality occurred in mixed conifer and spruce-fir stands.

Status of Major Insect Pests

Spruce beetle, Dendroctonus rufipennis (Kirby). Spruce beetle-caused tree mortality continued at epidemic proportions on the Pecos Ranger District, Santa Fe National Forest, and the Fort Apache Indian Reservation, Arizona. Spruce beetle populations were epidemic on approximately 8,000 acres of the Pecos Ranger District, where estimates of newly attacked trees ranged from 9.1 trees per acre in 1982 to 4.9 in 1983.

On the Fort Apache Indian Reservation, spruce mortality has been extensive since 1981. In 1983, an estimated 8,500 acres of reservation land were heavily infested. Approximately 15 million board feet of dead spruce were salvaged in 1983. Extensive surveys indicated spruce beetle populations were declining in some areas. However, an estimated 82.8 million board feet of timber remain unsalvaged to date.

Spruce mortality was also aerially detected on Questa, Penasco, and Valle Vidal units of the Carson National Forest; Espanola and Las Vegas Ranger Districts of the Santa Fe National Forest; and the Springerville Ranger District, Apache-Sitgreaves National Forests.

Mountain pine beetle, Dendroctonus ponderosae Hopk. The mountain pine beetle caused tree mortality in ponderosa pine stands at widely scattered locations in northern New Mexico and Arizona. Beetle activity was somewhat concentrated on the Tres Piedras Ranger District, Carson National Forest; North Kaibab Ranger Distirct, Kaibab National Forest; and the Jicarilla and Navajo Indian Reservations. Elsewhere, beetle activity was generally endemic, with resultant small groups of dead trees.

Ips engraver beetles, Ips spp. Ponderosa pine mortality caused by Ips beetles was widely scattered in New Mexico and Arizona. Areas of concentrated activity occurred on the Springerville, Chevelon, and Lakeside Ranger Districts, Apache-Sitgreaves National Forests, and the Fort Apache Indian Reservation. Ips activity in these locations was generally associated with thinning and prescribed burning operations.

Western spruce budworm, Choristoneura occidentalis Free. Defoliation caused by this insect occurred on an estimated 371,549 acres of mixed conifer forests in New Mexico and Arizona (figure 1). This defoliation level was down slightly from 368,485 acres reported in 1982. Areas with extensive defoliation included the Carson, Santa Fe, Cibola, and Lincoln National Forests in New Mexico, and the Kaibab National Forest and Grand Canyon National Park in Arizona. Other federally administrated lands extensively defoliated included the Mescalero Apache Indian Reservation and Taos Pueblo Indian Reservation. Approximately 20,724 acres of State and private lands were also defoliated. These data are summarized in table 1.

Figure 1. Locations of western spruce budworm infestations in 1983

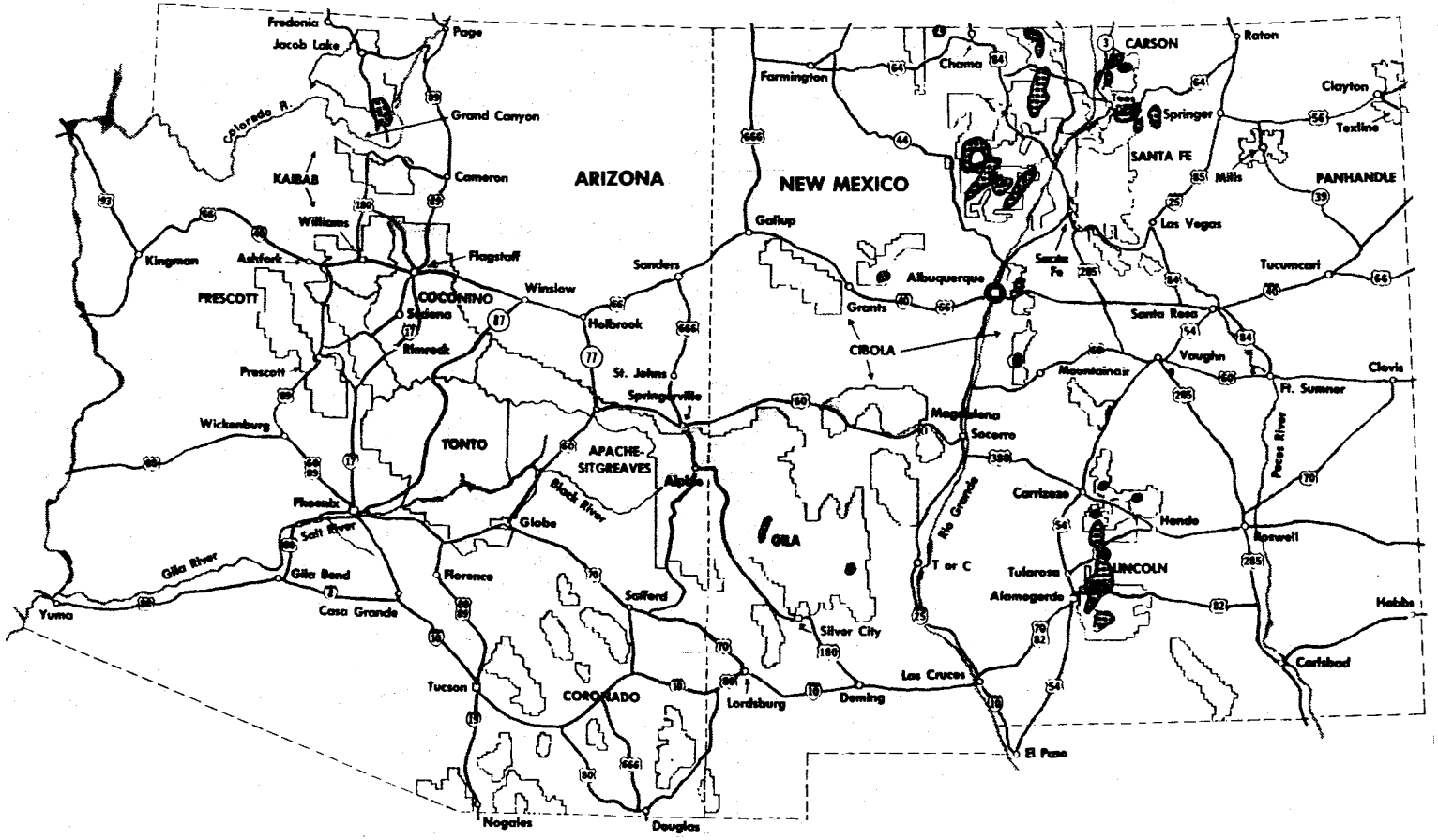

TABLE 1.--Status of western spruce budworm infestations, Southwestern Region, 1983

Class	Outbreak area (acres)			
	Light	Moderate	Heavy	Total
National Forest	106,175	137,100	13,650	256,925
Other Federal[1]	14,750	350	0	15,100
Indian Reservations	20,750	41,650	1,305	63,725
Private	32,985[2]	8,550	75	41,610

[1] Includes land administered by the National Park Service, Bureau of Land Management, and Department of Defense.
[2] Includes 26,533 acres not classed as light, moderate, or heavy

Budworm activity declined on the Carson, Cibola, and Santa Fe National Forests in New Mexico, and on the Kaibab National Forest and Grand Canyon National Park in Arizona. However, insect activity on the Lincoln National Forest and Mescalero Apache Indian Reservation increased dramatically. Egg mass surveys conducted within many infested areas indicated the outbreak would continue in 1984.

The western spruce budworm suppression and evaluation project in the Jemez Mountains was evaluated for the seventh consecutive year. Budworm populations in both the treated and untreated blocks appeared near equal. However, tree damage in the treated blocks was negligible, while the untreated blocks have suffered measureable tree damage.

Pandora moth, Coloradia pandora Blake. Defoliation of ponderosa pine by this insect occurred on 28,525 acres in the vicinity of Jacob Lake, North Kaibab Ranger District, Kaibab National Forest, Arizona. This outbreak was first detected in 1978 and continued to defoliate pine stands in 1983. Surveys conducted by Forest Pest Management have failed to discover any significant tree mortality as a result of this infestation. Basal area growth was reduced an estimated 25 percent due to defoliation.

A naturally occurring virus was prevalent in larval populations during May and June. Larval mortality reduced by virus was a factor resulting in lighter than expected defoliation. Virus rates were expected to increase, eventually regulating pandora moth populations.

Aspen defoliators. Acres of visibly defoliated aspen increased to 35,925 in 1983. The Carson and Santa Fe National Forests continued to sustain the heaviest defoliation. Other areas of significant defoliation occurred on the Cloudcroft Ranger District, Lincoln National Forest; the Flagstaff Ranger District, Coconino National Forest; and the Grand Canyon National Park. Defoliation was suspected to be a result of feeding by the western tent caterpillar, Malacosoma californicum Pack., and the large aspen tortrix, Choristoneura conflictana (Walker).

Status of Other Insects

Common name	Scientific name	Host	Locality	Remarks
Sawfly	Neodiprion spp.	Ponderosa pine	Kaibab NF, AZ	15-acre infestation
Tiger moth	Halisidota ingens	Ponderosa pine	Navajo IR, AZ Kaibab NF, AZ Carson NF, NM Fort Apache IR, AZ Apache-Sitgreaves NF's, AZ	Widespread and numerous reports. Population levels higher than usual
Douglas-fir tussock moth	Orgyia pseudotsugata	White fir, Spruce, and Douglas-fir	Santa Fe, NM Raton, NM	Common in ornamental trees
Sugar pine tortrix	Choristoneura lambertiana	Ponderosa pine	Carson NF, NM	Scattered
Pinyon needle scale	Matsucoccus acalyptus	Pinyon pine	Apache-Sitgreaves NF's, AZ	400- to 500-acre infestation
False powderpost beetle	Bostrichidae	Ponderosa pine	Acoma IR, NM	
Cedar bark beetle	Phloeosinus spp.	Juniper	Santa Fe, NM	Ornamental trees

Status of Pest Complexes

Widely scattered tree mortality and growth loss due to a complex of pests occurs annually throughout the coniferous forests of the Southwest. Mortality principally occurs in overmature trees predisposed to bark beetle attack or disease infection by drought, stand stagnation, fire, root disease, dwarf mistletoe, or poor growing site conditons. These losses are generally difficult to manage and thus accepted.

Douglas-fir mortality. Small, isolated groups of Douglas-fir mortality were detected on the Carson and Santa Fe National Forests, the Fort Apache Indian Reservation, and the Grand Canyon National Park. Total detectable acreage was estimated at 880. This mortality was due to a complex of pests, including the Douglas-fir beetle, Dendroctonus pseudotsugae, Hopk., root disease, and Douglas-fir dwarf mistletoe, Arceuthobium douglasii. In some areas, defoliation by the western spruce budworm was a contributing factor. Losses to this pest complex were down from 1982 estimates.

True fir mortality. Groups of true fir mortality were observed throughout much of the mixed conifer and spruce-fir forest types in the Region. Although somewhat speculative, mortality was a result of a complex of root disease and fir engraver beetle, Scolytus ventralis LeC. (in white fir), and western balsam bark beetle, Dryocetes confusus Swaine (in subalpine or corkbark fir). Approximately 11,820 acres of mortality were detected on the Apache-Sitgreaves, Carson, Cibola, Coconino, Gila, Lincoln, and Santa Fe National Forests, as well as the Grand Canyon National Park, Fort Apache Indian and Navajo Indian Reservations. This was a decline from 1982 estimates.

Ponderosa pine mortality. Widely scattered mortality, single trees or in small tree groups, was detected throughout much of the ponderosa pine type in the Southwestern Region. This activity was particularly prevalent on the Apache-Sitgreaves and Coconino National Forests, and the Fort Apache Indian Reservation. Most of this mortality was probably due to western pine beetle, Dendroctonus brevicomis LeC., or the red turpentine beetle, Dendroctonus valens LeC. These bark beetles mainly attack mature or overmature trees, weakened by lightning strikes, fires, disease, and other factors.

Status of Diseases

Dwarf mistletoes, Arceuthobium spp., continued to be the most damaging disease of conifers in the Southwestern Region. Southwestern dwarf mistletoe, A. vaginatum subsp. cryptopodum (Engelm.) Hawks. & Wiens, on ponderosa pine, is the most widespread and important of these pathogens and caused the largest losses.

Surveys were conducted this past year on 40,250 acres of infected ponderosa pine stands on seven Ranger Districts on five National Forests. The results of these surveys were used to write silvicultural prescriptions to manage the infected stands. In order to help select the most suitable atlernative, many of these stands were modeled using RMYLD2, a simulated growth and yield model that can project the effects of dwarf mistletoe in infected stands.

A roadside survey to determine incidence, intensity, and volume losses caused by dwarf mistletoes was conducted on the Apache-Sitgreaves National Forests, Arizona. A total of 14,304 acres of ponderosa pine type was surveyed; preliminary results will be available in 1984. The survey will continue in 1984 in the mixed conifer type on the Apache-Sitgreaves National Forests and pine type on the Kaibab and Coconino National Forests, Arizona.

Root diseases. A survey of commercial timber producing lands on six National Forests in Arizona and New Mexico determined numbers of trees and volumes, therein, killed by root diseases and associated pests. Mortality overall was light and scattered, about 0.08 trees per acre per year, representing 12 board feet per acre.

Root diseases and associated pests were responsible for about 34 percent (79,235) of the trees killed, and about 30 percent (9.7 million board feet) of the volume lost. A larger proportion of the mortality attributed to these pests was in mixed conifer and spruce-fir stands rather than in ponderosa pine stands. Shoestring root disease (Armillariella mellea) was associated with the death of about 78 percent of the root-diseased trees, containing about 80 percent of the volume lost; annosus root disease (Heterobasidion annosum) was found in the remainder. Losses not included in these estimates include trees smaller than 5 inches d.b.h., growth losses, and area out of production as a result of persistent agents.

Nursery diseases. Pre- and post-fumigation population surveys of soilborne pathogens at the Albuquerque Tree Nursery were conducted in the spring of 1983. Fumigation was effective in reducing levels of Fusarium and Pythium spp. to 66.67 and 0.05 proapagules per gram, respectively. At the end of the growing season, fumigated beds had an average of 26 trees per square foot, compared to 4 trees per square foot in unfumigated plots.

Hazard trees. An evaluation of potential hazard trees was conducted in 11 campgrounds, Questa Ranger District, Carson National Forest. The most common defects found were dead and rotten branches in hardwoods, primarily cottonwoods.

FOREST PEST CONDITIONS IN THE STATE OF ARIZONA

By Robert Celaya[1]

Pine engraver beetles, Ips spp. Scattered pinyons were attacked by the beetle in Payson in July and August. Urbanization-stressed trees suffered the most losses. The beetle was also active on healthy and dwarf mistletoe-infected ponderosa pines east of Payson in September. Late attacks on ponderosa pines were observed in Payson and Prescott in November and December. Fall beetle attacks at these lower elevations may have been precipitated by above-normal temperatures in September, October, and the first half of November.

Comandra blister rust, Cronartium comandrae Pk. This rust was identified for the first time on Eldarica pine, Pinus eldarica, in Prescott. Trees located in two areas in June and July exhibited branch dieback and the aecial stage found on the trunk. The rust does not appear to be affecting trees less than 7 years old. The alternate host, a toadflax, was also found growing profusely in the area and completely infected with the disease. This is the only area in the State where the rust has been encountered on Eldarica pine, but the alternate host exists statewide. Christmas tree growers will be notified of the potential problem this disease presents to their plantations.

Pinyon needle scale, Matsucoccus acalyptus Herbert. Another site for this pest was identified in Nutrioso, Arizona. A few saplings were infested, but they are not being seriously damaged. The area will be surveyed more extensively in 1984. The population located near Kingman in 1982 did not spread to surrounding trees. Females that were emerging from the scale stage in May appeared to have died of unknown causes. The chronic infestation in Prescott continued to cause severe defoliation and mortality to the local pinyons. Early female scale emergence was again detected in late March, but no egg laying occurred until April. The infestation is expected to continue defoliating and killing pinyons.

Dwarf mistletoes, Arceuthobium spp. Great emphasis was placed on the damaging effects of this parasite on ponderosa pines in 1983. As a result, several new areas in the State with serious dwarf mistletoe problems were identified. A private summerhome area northeast of Young, Arizona, will be surveyed to reduce dwarf mistletoe damage. Another parcel of private land near Christopher Creek will also be treated in 1984. Homeowners in the Crown King area will be notified of the presence of the parasite in their community and efforts to reduce its impact will be initiated in 1984. An additional problem with dwarf mistletoe in ponderosa pines has developed on State lands southwest of Flagstaff. Inconsistent results of dwarf mistletoe treatment have occurred and followup treatments may be necessary.

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[1] Forest entomologist with the Division of Forestry, Arizona State Land Department.

Closer supervision by division personnel during dwarf mistletoe reduction is needed. Dwarf mistletoe is also a serious problem in Alpine, Greer, Colcord Mountain Estates, Forest Lakes Estates, and the Lakeside-Pinetop area.

Pine tip moths, Rhyacionia spp. These insects were very widespread on ornamental and ponderosa pines in the Payson area in July and August. Aleppo, Eldarica, and Japanese black pines were thoroughly infested with these pests. Chemical treatment was suggested, but the damage has already occurred. The homeowners in the area will be notified if the pest again becomes a problem in 1984.

Pine needleminers, Coleotechnites sp., Exoteleia sp. Needleminers continued to discolor and defoliate ponderosa pines in the Lakeside-Pinetop area, with severity of defoliation varying throughout the area. This population has been identified since 1976 and is probably endemic to the area. No tree mortality has been noted as a result of the yearly damage.

Defoliation by this pest has also been noted in Parks, Arizona, in the past. Individual trees suffered severe discoloration and defoliation in 1984 and may be indicative of an expanding population. A closer examination of the area will be completed in 1984.

FOREST PEST CONDITIONS IN THE STATE OF NEW MEXICO[2]

Western spruce budworm, Choristoneura occidentalis Free. Defoliation by this insect was aerially detected on 41,610 acres of private lands. Areas of extensive defoliation included private lands in the Sacramento Mountains (6,825 acres), the Philmont Scout Ranch (11,420 acres), and the Baca Location (14,515 acres). Defoliation is expected to increase on these properties during 1984.

Western tent caterpillar, Malacosoma californicum. Approximately 24,440 acres of aspen were defoliated by this insect. Defoliation was particularly severe in the vicinity of Chama, where 19,130 acres were defoliated. Defoliation is expected to continue into 1984.

Oak defoliation, family Toricidae, genus unknown. An estimated 44,000 acres of Gambel oak were defoliated by an unidentified toricid in the vicinity of the Sargent Wildlife Refuge, Chama, and the Tierra Amarilla Grant. This outbreak is expected to continue near this level in 1984.

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[2] Compiled from information provided by Tony Smith, forest entomologist with the New Mexico Department of Agriculture.

Pine engraver beetles, Ips spp. Isolated single tree mortality was common at an endemic level throughout the host type. Increased levels of single-tree attacks and a few clusters were noted in conjunction with areas of severe Lophodermella infection as discussed below. While not a threatening situation at present, these areas bear careful watch in the event of continuance of Lophodermella.

Needle cast disease, Lophodermella spp. This needle cast disease was detected on approximately 20,350 acres of ponderosa pine, principally near Vermejo in the northern portion of the State. It has been associated with moister than usual conditions. This disease can be very damaging if it continues for several consecutive years. Affected needles turn chlorotic and drop off. Stress induced by this disease may offer an opportunity for a dramatic increase in bark beetle activity.

FOREST PEST MANAGEMENT ACTIVITIES IN 1983

Major activities of the Southwestern Region Forest Pest Management (FPM) staff include detection, evaluation, and suppression of forest pests and technical assistance to forest land managers on all Federal lands in Arizona and New Mexico. In addition, FPM personnel cooperated with the States of Arizona and New Mexico in carrying out forest pest management activities on State and private lands through the Cooperative Forest Pest Action Program.

Detection Surveys

Detecting and monitoring insect and disease outbreaks and infestations is a major responsibility of the FPM staff. This is accomplished by systematic low-level aerial surveys, ground examinations, and encouraging forest workers to report unusual and suspected insect and disease occurrences by means of field surveillance kits provided by FPM.

Aerial surveys were conducted from July through September over 10.5 million acres of coniferous forests in Arizona and New Mexico to determine the location and extent of damage caused by insects and/or diseases. Upon completion of the surveys, maps showing the location, relative intensity, and kinds of outbreaks were prepared and sent to the respective administrative units.

Ground examinations were made, when necessary, to confirm aerial detection observations, as well as in response to requests from land managers for detailed information or identification. State pest management specialists conducted ground surveys on State and private lands in Arizona and New Mexico.

A wide variety of insects and diseases were identified by the staff from surveillance reports sent by forest workers from across the Region. Such reports are important for the early detection of potential pest problems, and land managers and forest workers are encouraged to continue to be alert for, and prompt in, reporting any unusual insect of disease activity.

Evaluations

Another major responsibility of FPM is to evaluate forest pest problems and provide land managers with alternatives and recommendations for management through a variety of approaches. Twenty-one evaluations were conducted in 1983.

Entomology: The following new and continuing insect evalutions were conducted: (1) Spruce beetle on the Fort Apache Indian Reservation, Arizona; (2) a continuing assessment of budworm populations and damages on part of the Western Spruce Budworm Suppression and Evaluation Project Using Carbaryl-1977, Santa Fe National Forest, New Mexico; (3) results of the 1982 Western Spruce Budworm Suppression Project, Carson National Forest, New Mexico; (4) a report on the methods and results of a pilot project using Bacillus thuringiensis against the western spruce budworm in northern New Mexico; (5) an evaluation of western spruce budworm on the Lincoln National Forest and Mescalero Apache Indian Reservation, New Mexico; (6) an evaluation of western spruce budworm on the Carson National Forest, New Mexico; (7) an evaluation of western spruce budworm situations on the Santa Fe National Forest and Jemez and Santa Clara Indian Pueblos, New Mexico; (8) an assessment of spruce beetle populations and damage on Las Vegas Ranger District, Santa Fe National Forest, New Mexico; (9) results of a suppression project against the pandora moth, Kaibab National Forest, Arizona; (10) a continuing assessment of western spruce budworm damages on the Carson National Forest, New Mexico; and (11) an impact assessment of western spruce budworm damages on the South Cecilia timber sale, Santa Fe National Forest, New Mexico.

Pathology: Disease evaluations included: (1) Dwarf mistletoe control postsuppression surveys on the Tonto, Apache-Sitgreaves, and Kaibab National Forests, Arizona, covering a total of 968 acres; (2) interim postsuppression evaluations for four continuing projects on the Carson and Santa Fe National Forests, New Mexico; (3) forest pest conditions report on Taos Pueblo lands; (4) dwarf mistletoe biological evaluations on the Tonto National Forest, Arizona, and Carson National Forest, New Mexico, totaling 7,420 acres; (5) hazard tree evaluation of 11 campgrounds, Questa Ranger District, Carson National Forest, New Mexico; (6) biological evaluation of ponderosa pine mortality, Chevelon Ranger District, Apache-Sitgreaves National Forests; (7) evaluation of mortality caused by root disease and associated pests on Apache-Sitgreaves, Coconino, and Kaibab National Forests, Arizona, and Carson and Santa Fe National Forests, New Mexico; (8) biological evaluations on the effects of soil fumigation at the Albuquerque Tree Nursery on soilborne plant pathogen and seedlings, 1982 and 1983, Cibola National Forest, New Mexico; (9) hazard trees evaluation, Whitehorse Lake, Williams Ranger District, Kaibab National Forest, Arizona; and (10) evaluation to determine the cause of tree mortality at Capulin Mountain and Fort Union National Monuments, National Park Service, New Mexico.

Suppression Projects

Forest pests occasionally cause unacceptable damage to forest recources and must be managed by employing a combination of silvicultural, mechanical, biological, or chemcial suppression strategies.

During the past year, FPM conducted or participated in the following suppression projects: (1) Aerial applications of the insecticides carbaryl and B.t. to epidemic western spruce budworm populations (38,000 acres) on the Carson National Forest, New Mexico; (2) aerial application of acephate insecticide to epidemic pandora moth populations (650 acres) on the Kaibab National Forest, Arizona; (3) thinning, pruning, chipping, and/or removing infected trees to control dwarf mistletoe infestations on the Carson (2,166 acres) and Santa Fe (85 acres) National Forests, New Mexico.

RECENT PUBLICATIONS

Beatty, Jerome S. 1983. Biological evaluation, dwarf mistletoe, El Rito RD, Carson NF, N. Mex. R-3 83-11. 35 pp.

Beatty, Jerome S. 1983. Compiler. Forest insect and disease field guide. 76 pp.

Bennett, Dayle D., Andrews, Michael A. 1983. Biological evaluation, pandora moth, Kaibab National Forest, Arizona. R-3 83-7. 15 pp.

Bennett, Dayle D., Chavez, J. M., and Bousfield, Wayne E. 1983. Forest insect and disease survey system: A user's guide for the Southwestern Region. R-3 83-14. 22 pp.

Linnane, James P. 1983. Biological evaluation, spruce beetle, Fort Apache Indian Reservation, Arizona. R-3 83-6. 32 pp.

Norris, Richard, Wood, Robert E., and Beatty, Jerome S. 1983. Biological evaluation of soil fumigation at Albuquerque Tree Nursery on soil-borne plant pathogen and seedlings, Cibola National Forest, New Mexico. R-3 83-10. 15 pp.

Norris, Richard. 1983. Biological evaluation, effects of soil fumigation at Albuquerque Tree Nursery on soil-borne plant pathogens and seedlings, Cibola National Forest, New Mexico. R-3 84-2. 9 pp.

Ragenovich, Iral R. 1983. Pilot project to evaluate the operational use of Bacillus thuringiensis against the western spruce budworm in northern New Mexico--1981-82, Carson National Forest and State and Private lands, New Mexico, Prog. Rep. No. 1. R-3 84-1. 62 pp.

Rogers, T. J. 1983. Biological evaluation, western spruce budworm, Carson National Forest, New Mexico. R-3 84-4. 18 pp.

Telfer, William G. 1983. Western spruce budworm suppression and evaluation project using carbaryl--1977, Santa Fe National Forest and Jemez Pueblo Indian Reservation, New Mexico. R-3 83-9. 17 pp.

Telfer, William G., Linnane, James P., and Davis James H. 1983. Western spruce budworm suppression project--1982, Carson National Forest and State and Private lands, New Mexico. R-3 82-12. 36 pp.

Telfer, William G. 1983. Biological evaluation, western spruce budworm, Lincoln National Forest and Mescalero Apache Indian Reservation, New Mexico. R-3 84-3. 22 pp.

Telfer, William G. 1983. Biological evaluation, western spruce budworm, Santa Fe National Forest, Jemez Indian Pueblo, and Santa Clara Indian Pueblo, New Mexico. R-3 84-5. 16 pp.

Wood, Robert E. 1983. Mortality caused by root diseases and associated pests on six National Forests in Arizona and New Mexico. R-3 83-13. 31 pp.